



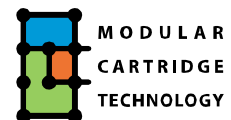
Hydrogen Fuel Cell  
Codes & Standards  
HTAC  
October 15, 2010

When You Can't Afford To Be Without Power

# Company Profile



- Incorporated 1995
  - Initial private funding: 2003
  - Headquarters: Spokane, WA
- 46 employees
- Strong intellectual property portfolio
- Commercial products deployed since 2003 with more than 100 customers
  - Over 3,000kW at ~1,100 sites
- Supply contracts established with all major U.S. telecom operators
- Strategic relationships in place with major power systems integrators
- Multiple ongoing R&D projects
  - Conductive Ceramic Technology
  - Polymer & Catalyst technology
  - Hydrogen storage & generation

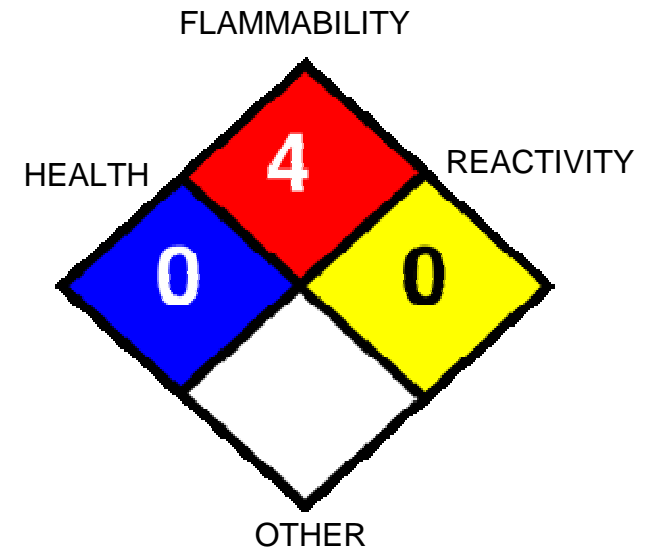


- ReliOn Inc. adheres to many codes, standards and certifications.
- Our business is dictated by regulation.

- NFPA Standards:
  - **70:** National Electric Code
  - **496** Standard for Purged and Pressurized Enclosure for Electrical Equipment, 1998
  - **497** Recommended Practice for the Classification of Flammable Liquids, Gases or Vapors and of Hazardous Locations for Electrical Equipment, 1998
- CGA:
  - **E – 11** Standard for Stationary Compressed Cylinder Discharging Manifolds for Working Pressures up to 3000 PSI
  - **G – 5.4** Standard for Hydrogen Piping systems at consumer Locations
- ASME/ANSI
  - **B31.3** – Process Piping Code
- ANSI/CSA:
  - **FC1** – Standard for Stationary Fuel Cell Power Systems
- NEBS:
  - **GR 487, GR 1063, & GR 1089**

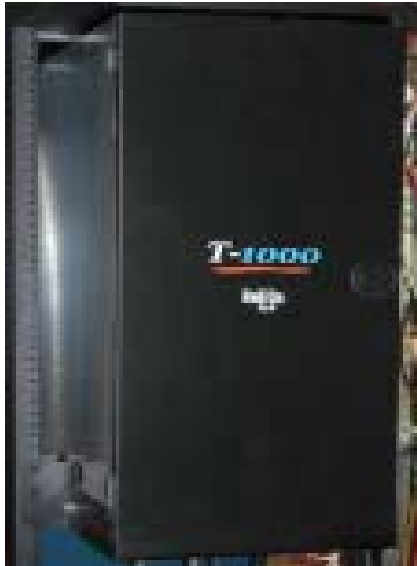
- NFPA Standards:
  - **853:** Standard for Installation of Stationary Fuel Cell Power Plants, 2003
  - **55:** Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks, 2005
  - **NFPA 70A:** National Electric Code
- IFC/IBC Codes:
  - Ch. 27 Hazardous Materials – General (Table 2703.1.1)
  - Ch. 35 Flammable Gases (Table 3504.2.1)
- Codes focused around:
  - Fuel storage setback distances
  - Gas/electrical safety

- Authority Having Jurisdiction (AHJ)
  - Federal, State, County, or Municipality
  - Fire Marshal and/or other permitting agency
    - Planning/Zoning/Building/Fire
- Primarily Looking for:
  - Listed commercial equipment
    - UL or CSA Listed
  - Safe Installation Practices
    - Adequate access to cabinet
    - Proximity to known spark sources
    - Likelihood of hazardous situations

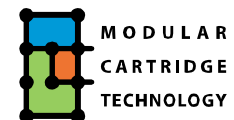


NFPA 704 HAZARD DIAMOND  
FOR HYDROGEN

# Indoor Applications



- The systems are Listed by UL and CSA for indoor applications using the appropriate recognized and listed components as required by the standard.
- The systems are certified to ANSI/CSA FC 1 - 2004 "Stationary Fuel Cell Power Systems."
- The units are also CE certified by the notified body of GASTEC Certification BV.
- File Numbers are:
  - Underwriters Laboratory: E215217
  - Canadian Standards Association: 212221
  - Gastec Report Number: 123289.010
- The UL & CSA listings cover the fuel cell system product, including the insulating shell and low pressure regulator.



# Outdoor Application



- The units are Listed by UL and CSA for direct outdoor applications using the appropriate recognized and listed components as required by the standard.
- It is certified to ANSI/CSA FC 1 -2004 “Stationary Fuel Cell Power Systems.”
- File Numbers are:
  - Underwriters Laboratory: E215217
  - Canadian Standards Association: 212221
- The UL & CSA listings cover the fuel cell system product, including the insulating fuel cell cabinet and low pressure regulator.



# NEBS Compliant Systems



- Test to Verizon TPR:
  - VZ.TPR.9801 Fuel Cell Systems NEBS Testing Requirements
- Systems must incorporate ANSI/CSA FC 1-2004 listed fuel cell systems
- NEBS testing includes outdoor enclosures and fuel storage cabinets

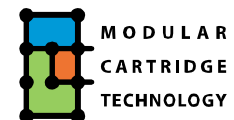


1.2kW 1-meter  
Outdoor Enclosure



1.2kW Extended Run  
Outdoor Enclosure

T-1000® Fuel Cell Systems



# NEBS Compliant Systems (continued)



4,000 Watt - 48 kWh Configuration

4-kW Outdoor  
Enclosure



6,000 Watt - 48 kWh Configuration

6-kW Outdoor  
Enclosure

T-2000® Fuel Cell Systems

# Certification Compliance



- NEBS certified solutions
- CSA
- CE
- UL
- FCC
- Field proven operation



**NEBS Cold Weather Operation**



**NEBS Brushfire Testing**



- ReliOn Permitting Guide
  - Based upon recognized standards combined with ReliOn's knowledge of the industry and the properties of the fuel.
- Hydrogen Executive Leadership Panel (HELP) Sheet
  - Set Backs based upon IFC/IBC and manufacturers' recommendations
  - ReliOn's Set Back recommendations are based on this compilation of data.

# Site Evaluation Worksheet



## Site Evaluation Worksheet for Flammable Gas Storage Stationary Hydrogen Fuel Cells

2006 editions of the International Building Code, International Mechanical Code and International Fuel Gas Code, which have references to the International Fire Code.

| Typical hydrogen storage siting criteria for quantities less than 4,226 standard cubic feet (scf) and 4,226 to 21,125 scf. Interpretation by the Authority Having Jurisdiction (AHJ) will determine final setback distances. |  | Controlling Code    | Setback<br><4,226 scf | Setback<br>4,226 to<br>21,125<br>scf |
|--|--|---------------------|-----------------------|--------------------------------------|
| Buildings on the same property <sup>c</sup>  | Non-rated construction or openings within 25 ft  | IFC Table 3504.2.1  | 5 ft                  | 10 ft                                |
|  | 2-hour construction and no openings within 25 ft | IFC Table 3504.2.1  | 0 ft                  | 5 ft                                 |
|  | 4-hour construction and no openings within 25 ft | IFC Table 3504.2.1  | 0 ft                  | 0 ft                                 |
| Underground flammable or combustible liquid storage, distance to vent or fill opening <sup>b</sup>   |  | Recommend           | 5 ft                  | 10 ft                                |
| Ignition sources (including appliance burner igniters, hot work and hot surfaces capable of igniting flammable vapors) <sup>b</sup>  |  | Recommend           | 5 ft                  | 10 ft                                |
| Overhead electric utilities <sup>b</sup>   | Overhead electric wire                           | Recommend           | 5 ft                  | 10 ft                                |
|  | Overhead bus, trolley or train wire              | Recommend           | 5 ft                  | 10 ft                                |
| Public streets, public alleys or public ways <sup>a,c</sup>  |  | IFC Table 3504.2.1  | 5 ft                  | 10 ft                                |
| Distance to lot lines of property that can be built upon <sup>a,c</sup>  |  | IFC Table 3504.2.1  | 5 ft                  | 10 ft                                |
| Dry vegetation and combustible materials <sup>c</sup>  |  | IFC 2703.12/2704.11 | 15 ft                 | 25 ft                                |
| Above ground flammable or combustible liquid storage <sup>b</sup>  | Diked, distance to dike                          | Recommend           | 5 ft                  | 10 ft                                |
|  | Not diked, distance to tank                      | Recommend           | 5 ft                  | 10 ft                                |
| Additional flammable gas storage areas <sup>c</sup>  |  | IFC Table 3504.2.1  | 5 ft                  | 10 ft                                |

- a. The minimum required distances shall not apply when fire barriers without openings or penetrations having a minimum fire-resistance rating of 2 hours interrupt the line of sight between the storage and the exposure. The configuration of the fire barrier shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.
- b. These distances are recommended based upon the distances contained within IFC Table 3504.2.1.
- c. These distances are specified in the International Fire Code, 2006 edition.

Revision Date: June 25, 2010

Figure 5-1 Hydrogen Setback Distances

- Not all AHJ's use the same references
  - NFPA 55
  - International Building Code (IBC)
  - International Fire Code (IFC)
- No arbitration possible if AHJ misinterprets code language; even when faced with the facts
  - “Letter of the law” vs. “intent of the language”
- MAQ, ‘Maximum Allowable Quantity’...Code interpretation
  - IFC 3504.2.1 clearly describes how to handle large quantities

- Most AHJ's lack experience with Hydrogen
  - Fear of the Unknown; Hindenburg or mushroom cloud!
  - Some treat installs as “Science Projects” vs. commercial deployments
  - Uninformed/conservative interpretations lead to non-value-added steps
    - Unnecessary pressure testing often requested
    - Proof of detailed internal component testing as if the apparatus was a custom
    - Not the same for Diesel / Propane Gen-Sets (uneven playing field)
    - Require more inspections leading to higher install cost and project delays

- Southern California Edison – Electrical Utility
  - NIMBY
  - A member of California Hydrogen Business Council, but unwilling to allow hydrogen on any of their properties
- American Tower Company – Wireless Site Landlord
  - Excessive Set Backs
  - Interpretation of NFPA/OSHA standards drives them to enforce large H<sub>2</sub> quarantine zones at their sites
  - Makes site rental economically infeasible for fuel cells

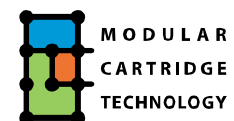


# Storage allowances for Infrastructure Fuels



| Fuel Type | Allowable onsite Storage<br>Quantity/ BTU                            | Special Conditions  |
|-----------|--|---|
| Diesel    | 275 gallons<br>139,000 BTU's/gallon<br><b>38,225,000 BTU's/site</b>  | Data from Table 4.3.2.1.1(a) and (b), NFPA 30 Flammable Liquids Code 2006   |
| Gasoline  | 275 gallons<br>124,000 BTU's/gallon<br><b>34,100,000 BTU's/site</b>  | Data from Table 4.3.2.1.1(a) and (b), NFPA 30 Flammable Liquids Code 2006   |
| LPG       | 1200 gallons<br>91,600 BTU's/gallon<br><b>109,120,000 BTU's/site</b> | 5 foot minimum between relief valve discharge and external source of ignition (air conditioner), direct vent, or mechanical ventilation system (attic fan). |
| Hydrogen  | 3400cuft<br>270 BTU's/cuft<br><b>945,000/site</b>                    | NFPA restricts proximity to occupied structures, ventilation ducts....  |

Allowable Hydrogen on site storage is at least one order of magnitude lower than other fuels by BTU content.



# Thank You



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